

QUALITY OF AGRICULTURAL DRAINAGE DISCHARGING
TO THE SAN JOAQUIN RIVER FROM THE SOUTH DELTA ISLANDS
JANUARY 1986 TO OCTOBER 1987

California Regional Water Quality Control Board
Central Valley Region
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CALIFORNIA REGIONAL WATER QUALITY CONTROL BOARD
CENTRAL VALLEY REGION

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TABLE OF CONTENTS

	<u>Page</u>
EXECUTIVE SUMMARY	1
INTRODUCTION	2
STUDY AREA	3
METHODS	3
RESULTS	7
REFERENCES	13
APPENDIX A. Water Quality Data for Agricultural Drainage That Flows From Selected Delta Islands Into the San Joaquin River and Delta Waterways	14
APPENDIX B. Department of Water Resources Delta Health Effects Study for Selected Sites, August 1987	22

LIST OF TABLES

Table 1. Location Map Site Index	5
Table 2. Summary of Selected Constituent Ranges for Drains That Flow Into the Delta Waterways From Islands in the South Delta During the Period January 1986 to October 1987	8
Table 3. Summary of Constituent Concentration Ranges for the 1987 Irrigation Season	9
Table 4. Frequency Distribution of Selected Constituent Concentrations For Drains That Flow Into the Delta Waterways From Islands in the South Delta During the Period January 1986 to October 1987	10

LIST OF FIGURES

Figure 1 Location Map of Study Area Showing Delta Upland and Lowland Areas	4
Figure 2. Location Map of Drainage Monitoring Sites That Flow Into the South Delta Waterways	6
Figure 3. Chemical Composition of Water Samples for Selected Areas	12

EXECUTIVE SUMMARY

As part of the statewide effort to identify sources of selenium and their potential impacts, the Central Valley Regional Water Quality Control Board (Regional Board) was requested to monitor and assess sources of agricultural drainage for selenium. One of the sixteen areas identified for drainage assessment was the Southern Delta area. The Regional Board conducted a water quality monitoring program from January 1986 to October 1987 to evaluate discharges to the San Joaquin River and Delta from the South Delta Islands. The purpose was to compile a database for selenium and other inorganic constituents found in the discharge water. The goal was to use this database to compare the quality of these discharges to others in the State and assess whether the potential exists for beneficial use impairment.

A database was established as samples were collected from 46 discharge sites throughout the South Delta lowlands. Sampling shows that the drainage water discharges are of better quality than those discharged further upstream. For example, those discharged through the Grassland Area show a median total dissolved solids concentration of 4,800 mg/L with a strongly sulfate dominated water while those originating from the South Delta lowlands had a median concentration of 770 mg/L with a slightly chloride dominated water. The majority of the samples collected from the drainage discharges in the South Delta lowlands were of a quality that they could be used directly for crop irrigation without any harmful effects.

The trace element concentrations in the samples collected in this survey were low. The median selenium concentration for all the samples collected was 0.7 µg/L with over 85 percent of the samples collected showing concentrations below 2.0 µg/L, a concentration guideline used by the U. S. Fish and Wildlife Service for wetland protection. This compares to a median value of 120 µg/L selenium being discharged from drains in the Panoche Fan. None of the selenium concentrations measured in this study would present a potential impact to beneficial uses in the Delta.

Further sampling for trace elements measured in this study, including selenium, in agricultural drainage water discharges is not needed in the lowland area of the South Delta. Measured concentrations do not pose a threat to beneficial uses.

INTRODUCTION

The Agricultural Unit of the Central Valley Regional Water Quality Control Board (Regional Board) initiated a monitoring program in January 1986 to evaluate the quality of agricultural drainage water discharges to the San Joaquin River and Delta from the South Delta Islands. The purpose of this monitoring program was to compile a data base for selected inorganic constituents found in the agricultural drains that are discharging into the South Delta or San Joaquin River. The focus is on irrigation tailwater and subsurface drainage water that is being returned to the Delta waterways.

The majority of the subsurface agricultural drainage pollutant load is discharged to the San Joaquin River via Mud Slough (north) and Salt Slough in Merced County (James et al., 1988a and 1988b, Westcot et al., 1989a and Chilcott et al., 1989). The impact of these discharges, however, is highly modified by numerous surface and subsurface discharges downstream of these two sloughs. The importance of these downstream discharges is manifested by the finding that in many months of the year the majority of flow in the San Joaquin River downstream of the Salt Slough and Mud Slough (north) inflows is agricultural return flows.

The water quality of the San Joaquin River is thus highly modified by the time it reaches the Delta. This river water is the supply water for the Delta islands and part of the study effort has been directed at setting a baseline on whether this source irrigation water is effecting quality of the discharge water similar to what was found in western Stanislaus County (Westcot et al., 1986b).

The river water is further modified in the Delta by localized withdrawals and discharges. The main influences on the San Joaquin River flow in the Delta are the U.S. Bureau of Reclamation and State Water Project export pumps located near Tracy. The majority of the river flow returns to these pumps. The quality of the San Joaquin River is also influenced by localized subsurface drainage water discharges upstream and downstream of the project pumps. Little information is available on the quality and magnitude of these localized discharges.

The most significant discharges in the Delta Area occur from the western side of the San Joaquin River in both San Joaquin County and Contra Costa County as well as from the Delta Islands. Previous reports detailed the characteristics of drainage water entering from the upland Delta areas of eastern Contra Costa County (Westcot et al.,

1989c) and the western portion of San Joaquin County (Belden et al., 1989). The objective of this study is to characterize the discharges known to enter the Delta waterways from the lowland areas within the South Delta Islands and determine if their quality is being affected by upstream discharges. The goal is to develop a data base that can be used to assess whether beneficial use impairment can potentially occur.

STUDY AREA

The study area is located in the southern portion of Sacramento - San Joaquin Delta and covers approximately 200 square miles of irrigated agricultural land (Figure 1). The focus is on the southern lowland island areas and waterways. Four of the 46 sites are located within Contra Costa County while the remaining 42 sites are located in San Joaquin County. The sites and description of their locations are listed in Table 1 and shown on Figure 2.

The soil characteristics of the lowland Delta areas consist of mineral soils in the southernmost portion of the study area with increasing organic materials to the north with peat as the dominant organic material. The mineral soil reflects the deltaic materials derived from mixed geologic origin of the Coast Range along the southwestern margin of the area. The organic soils reflect the advanced decomposition of materials such as peat, sedges, and tule reeds under the swampy conditions of the Delta lowlands.

Agricultural crops grown in the mineral soil area include alfalfa, tomatoes and other field crops while barley, beets, corn, potatoes and asparagus are grown within the organic soil area.

METHODS

The study was initiated in January 1986 and periodic sampling was conducted through the beginning of October 1987. The frequency of sample collection for this monitoring program varied but generally grab samples were collected bimonthly during the irrigation season with additional samples taken at selected times during the nonirrigation season. This sampling frequency was supplemented by the August 1987

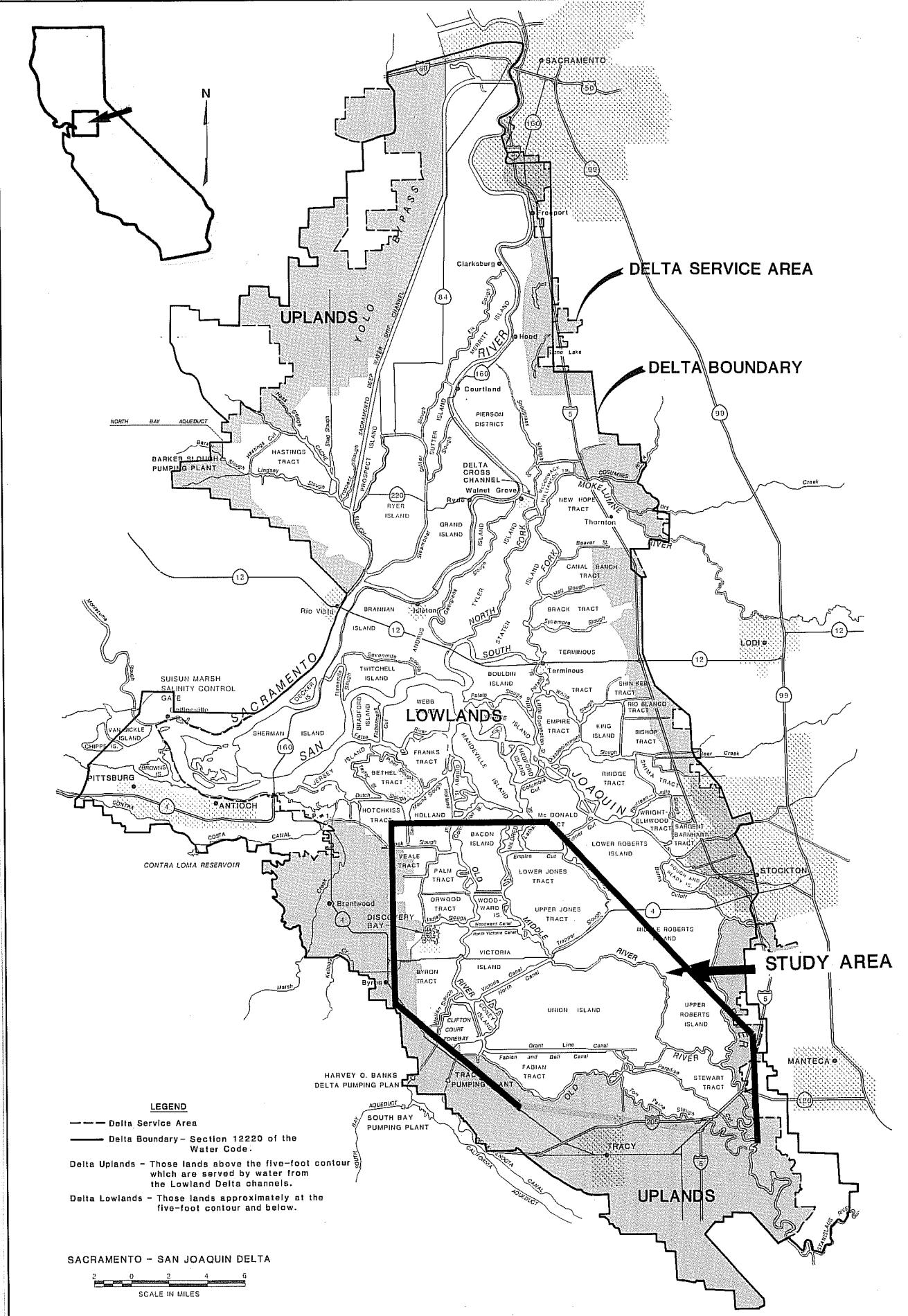
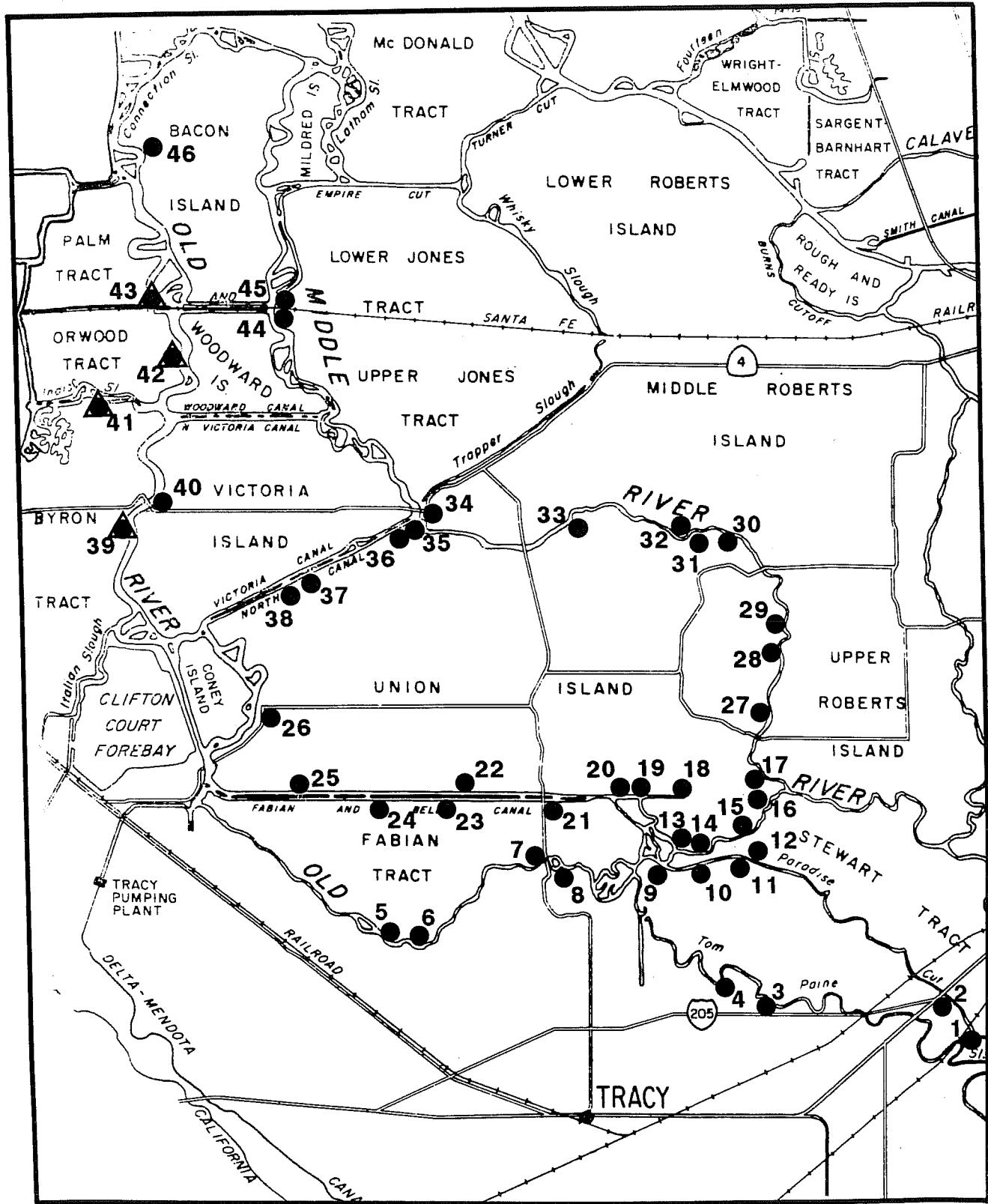


Table 1. Location Map Site Index.

Index #	Site ID	Location	Discharges to:
1	SJC721	Deuel Vocational Institute	Paradise Cut
2	SJC720	Paradise Mutual at Paradise Cut	Paradise Cut
3	SJC722	Pescadero RD	Tom Paine Slough
4	SJC723	RD 1007 / RD 2058	Tom Paine Slough
5	SJC708	Fabian Tract South #2	Old River
6	SJC707	Fabian Tract South #1	Old River
7	SJC706	Fabian Tract East	Old River
8	SJC729	RD 1007 at Old River east of Tracy	Old River
9	SJC727	Pescadero RD Pump north of MacArthur	Paradise Cut
10	SJC726	Pump west of Tom Paine Slough	Paradise Cut
11	SJC725	Pescadero RD north of Delta Ave	Paradise Cut
12	SJC724	Stewart Tract	Paradise Cut
13	SJC733	Union Island RD #2, Old River #1	Old River
14	SJC734	Union Island RD #2, Old River #2	Old River
15	SJC735	Union Island RD #2, Old River #3	Old River
16	SJC736	Union Island RD #2, Old River #4	Old River
17	SJC737	Union Island RD #2, Middle River #1	Middle River
18	SJC732	Union Island RD #2, South #3	Grant Line Canal
19	SJC730	Union Island RD #2, South #1	Grant Line Canal
20	SJC731	Union Island RD #2, South #2	Fabian & Bell Canal
21	SJC747	Fabian Tract North #3	Fabian & Bell Canal
22	SJC711	Union Island RD #1, South #1	Grant Line Canal
23	SJC710	Fabian Tract North #2	Fabian & Bell Canal
24	SJC709	Fabian Tract North #1	Fabian & Bell Canal
25	SJC713	Union Island RD #1, Southwest #1	Grant Line Canal
26	SJC712	Union Island RD #1, West	Old River
27	SJC738	Union Island RD #2, Middle River #2	Middle River
28	SJC739	Union Island RD #2, Middle River #3	Middle River
29	SJC740	Union Island RD #2, Middle River #4	Middle River
30	SJC741	Unio Island Northeast #1	Middle River
31	SJC742	Union Island Northeast #2	Middle River
32	SJC744	The Pocket RD 524, Southeast	Middle River
33	SJC743	Union Island RD #2, Northwest	Middle River
34	SJC704	Drexler Tract West	Middle River
35	SJC718	Union Island RD #1, North #2	North Canal
36	SJC716	Union Island RD #1, North #1	North Canal
37	SJC715	Union Island RD #1, Northwest #1	North Canal
38	SJC746	Union Island RD #1, Northwest #2	North Canal
39	CCC701	Byron Tract East	Old River
40	SJC705	Victoria Island West	Old River
41	CCC704	Byron Tract North	Indian Slough
42	CCC702	Orwood Tract	Old River
43	CCC703	Palm Tract	Old River
44	SJC701	Upper Jones Tract Northwest	Middle River
45	SJC702	Lower Jones Tract Southwest	Middle River
46	SJC703	Bacon Island West	Old River



- Location of San Joaquin County Sites
- ▲ Location of Contra Costa County Sites

Figure 2. Location Map of Drainage Monitoring Sites that Flow Into The Southern Delta Waterways.

sampling at selected sites by the California Department of Water Resources (DWR) as part of their Delta Agricultural Drainage Investigation. Additional Regional Water Quality Control Board (RWQCB) data from sampling within other study areas is referenced to provide comparisons as to the variability of drainage water influencing the San Joaquin River and southern Delta.

All samples were analyzed for total recoverable selenium, boron, chloride, sulfate, total alkalinity and electrical conductivity (EC). Selected sites during 1986 were tested for total recoverable copper, chromium, lead, mercury, molybdenum, nickel, and zinc. Water temperature, pH, EC and sample time were recorded in the field at each site. All samples were collected in polyethylene bottles. All sample bottles were washed and acid rinsed in the laboratory prior to use and rinsed three times with the water to be sampled prior to sample collection. Selenium and other trace element samples were preserved by lowering the pH to less than 2 using ultra-pure nitric acid fixation techniques. All samples were kept on ice until preservation or submittal to the laboratory for analysis.

A quality control and quality assurance program was conducted utilizing spike and duplicate samples in the laboratory. Blind replicate samples were collected at 10 percent of the sites and 50 percent of the blind replicates were spiked for laboratory quality assurance. All reported results fall within the quality assurance tolerance guidelines.

RESULTS

Concentrations of measured constituents varied between discharge site, time of year, and between years. Statistical ranges of minerals and trace element constituents are summarized in Table 2. Water quality data and other physical properties for individual sites are given in Appendix A.

The median salinity (EC) concentration was 1080 $\mu\text{mhos}/\text{cm}$ for all the drainage water samples collected in the Southern Delta study area (Table 2). This compares to a median of 680 $\mu\text{mhos}/\text{cm}$ reported for the entire central and southern Delta area by DWR during their August 1987 sampling (Table 3 and Appendix B), and a median of 630 $\mu\text{mhos}/\text{cm}$ in the San Joaquin River at Mossdale which represents the source irrigation water quality as it enters the South Delta area. The median chloride

concentration of the samples collected in this study was 150 milligrams per liter (mg/L) (Table 2). This compares to a median chloride concentration of 89 mg/L reported by DWR for their August 1987 sampling (Table 3). The median sulfate concentration was 120 mg/L with 94 percent of the concentrations below 400 mg/L. This compares to a median sulfate concentraton of 66 mg/L reported by DWR for their August 1987 sampling (Table 3). The highest concentrations detected in this study for salinity, chloride, and sulfate were found at sites located in the southernmost portion of the study area with a gradational difference northward. The lower median concentrations found by DWR in August, 1987 suggest that this gradational difference from north to south occurs throughout the Delta. Data are insufficient in this study however to determine which factor has the stronger influence on the quality of drainage water from the South Delta Islands. It may be influenced by the local streams and soil types, but data is insufficient in this study to draw conclusions.

Table 2. Summary of Consituent Ranges for Drains that Flow Into the Delta Waterways Compared to San Joaquin River Water Quality as it Enters the Study Area During the Period January 1986 to October 1987.

	Drainage from the South Delta Islands				San Joaquin River at Mossdale Bridge			
	Minimum	Median	Maximum	N	Minimum	Median	Maximum	N
EC(µmhos/cm)	121	1080	4500	157	240	630	900	23
Se (µg/L)	0.1	0.7	8.0	325	0.8	1.4	3.4	25
B (mg/L)	0.1	0.3	4.0	325	<0.01	0.4	0.8	25
Cl (mg/L)	9.0	150	910	323	25.0	79	120	25
SO4(mg/L)	7.0	120	960	236	26.0	78	145	21
Alkalinity(mg/L)	28	130	860	237	24	84	130	18
Hardness(mg/L)	100	430	1100	31	59	165	260	6
TDS (mg/L)	170	770	2900	31	130	295	500	6
Ca (mg/L)	19	120	230	31	12	26	66	6
Na (mg/L)	28	170	510	31	21	56	89	6
Mg (mg/L)	8.0	74	240	31	6.0	14	17	6
K (mg/L)	1.1	2.8	9.0	30	1.9	3.5	5.3	6
Mo (µg/L)	<5	<5	30	119	<1	5	12	16
Cu (µg/L)	<1	4	23	119	<1	3	5	15
Cr (µg/L)	<5	1	25	119	<1	2	11	15
Ni (µg/L)	<5	6	36	119	3	<5	44	15
Pb (µg/L)	<5	<5	10	119	<5	<5	7	15
Zn (µg/L)	<5	8	90	119	<1	4	9	8
Hg (µg/L)	<0.5	<0.5	<0.5	119	<0.2	<0.5	<0.5	14

Boron was detected in all samples collected. The median concentration was 0.3 mg/L. Only 2 percent of the values exceeded 3.0 mg/L, a concentration above which severe restrictions on direct use for irrigation would occur (Westcot and Ayers, 1984). Eighty percent of the samples collected however were below 0.7 mg/L, a value considered to show no effect on crops when the water is used directly without dilution. The higher

concentrations were associated with three sites (site #3, 4, and 39). The quality found at site #39 on Byron Tract may be associated with runoff from the westside coastal streams that are known to have high boron levels. A median concentration of 4.1 mg/L was found for streams in the immediate area (RWQCB data). Mountain House Creek, which shows a median boron concentration of 8.1 mg/L, discharges to Old River immediately upstream of site #39 and may strongly influence the return drainage quality. The other two sites (#3 and 4) are located near each other and discharge to Tom Paine Slough. These discharges are in close proximity to the upland areas of western San Joaquin County. A recent report indicated a median boron concentration of 2.5 mg/L for the entire upland Delta area of San Joaquin County and a median concentration of 1.5 mg/L for sites in the vicinity of these two sites (Belden et al., 1989). These two sites and site #39 are the only locations where boron concentrations remain consistently above 1.0 mg/L throughout the year (Appendix A). The highest boron concentrations at these sites were found in the winter months and are likely attributed to lower dilution levels from irrigation surface water discharges that occur in the spring and summer.

Table 3. Summary of Constituent Concentration Ranges for the 1987 Irrigation Season.

Drainage from the South Delta Islands				Drainage from the Central and South Delta Islands **				
	Minimum	Median	Maximum	N *	Minimum	Median	Maximum	N *
EC(µmhos/cm)	121	1020	3880	178	173	680	1970	42
Se (µg/L)	0.09	1.0	6.2	178	0.1	0.8	2.5	43
B (mg/L)	0.09	0.34	3.2	178	<0.1	0.3	1.0	42
Cl (mg/L)	9.0	140	910	178	7.0	89	300	42
SO4 (mg/L)	7.0	110	540	90	8.0	66	226	42
Alkalinity(mg/L)	40	100	277	127	58	141	454	42
Hardness(mg/L)	120	330	610	10	59	195	492	42
TDS (mg/L)	250	574	1400	10	109	421	1220	42
Ca (mg/L)	23	65	140	10	12	40	103	42
Na (mg/L)	39	84	260	10	11	69	274	42
Mg (mg/L)	11	33	78	10	7.0	23	59	42
K (mg/L)	1.3	2.0	7.5	10	0.5	3.3	10	42

* N = Number of samples tested.

** Summary of DWR Delta Agricultural Drains Study Water Quality Data listed in Appendix B.

The median selenium concentration was 0.7 micrograms (µg/L). As shown in Table 4, only 15 percent of the samples collected from the South Delta drainage discharges showed concentrations above 2.0 µg/L while over 60 percent were below 1.0 µg/L. The highest levels recorded were from sites in the southern portion of the study area with only two sites showing concentrations consistently above the 2.0 µg/L level. These sites (site #3 and 4) are the same sites which were shown to have elevated boron concentrations. Data were not adequate in this study to determine if these

elevated selenium concentrations are associated with natural quality of the drainage water in the upland Delta areas (Belden et al., 1989), the higher selenium concentrations in the San Joaquin River which is used as the irrigation supply water, or the higher selenium concentrations observed in soils in the extreme southern Delta (Tidball et al., 1989). Drainage water from the upland areas showed a median selenium concentration of 2.3 µg/L while the New Jeruselem Drainage District which is in close proximity to the two sites indicated a median concentration of 4.6 µg/L (Belden et al., 1989). Water quality sampling of the San Joaquin River at Mossdale near these two sites showed a median selenium concentration of 1.4 µg/L during the study period. With the exception of the two sites, the median selenium concentrations discharged from other sites is less than 2.0 µg/L, the concentration guideline used by the U.S. Fish and Wildlife Service for water use in wetland habitats.

Table 4. Frequency Distribution of Selected Constituent Concentrations For Drains that Flow into the Delta Waterways from Islands in the South Delta During the Period January 1986 to October 1987.

EC ($\mu\text{mhos/cm}$)	N	Percentage
<700	76	23
701-2000	203	62
2001-3000	35	11
3001-4000	9	3
>4000	2	>1

Boron (mg/L)	N	Percentage
<0.7	226	80
0.7 - 1.5	38	13
1.6 - 2.5	7	3
2.6 - 3.0	5	2
>3.0	6	2

Selenium ($\mu\text{g/L}$)	N	Percentage
<1	200	61
1 - 1.9	77	24
2 - 4.9	45	14
5 - 10	3	1
>10	0	0

Chloride (mg/L)	N	Percentage
<100	94	29
100 - 350	179	56
351 - 500	31	10
501 - 1000	17	5
>1000	0	0

Sulfate (mg/L)	N	Percentage
<100	97	41
100 - 400	125	53
401 - 700	13	6
701 - 1000	1	<1
>1000	0	0

Molybdenum ($\mu\text{g/L}$)	N	Percentage
<5	73	61
5 - 10	37	31
11 - 25	8	7
26 - 50	1	1
>50	0	0

N = Number of samples tested showing this concentration.

Molybdenum was detected with concentrations above 5 µg/L in 39 percent of the samples tested (Table 4.). Of these, only 8 percent had concentrations over the 10 µg/L concentration at which there is concern for molybdenum buildup in cattle forage if the water is used for irrigation of forage pasture. The highest concentration of 30 µg/L was detected only once and follow up testing was reported at a concentration of 14 µg/L. The majority of the samples tested did not exceed a concentration of 19 µg/L, the criteria for freshwater aquatic life suggested by the San Joaquin River Technical Committee (SWRCB, 1987). Mercury was detected in only three samples collected. The maximum concentration of 2.6 µg/L was found only once and in follow up sampling of the site, no mercury was detected.

The chemical composition of agricultural drainage water from the South Delta Islands, the Panoche Fan area, and western Stanislaus County is shown in Figure 3. The diagrams show the relative contribution of major cations and anions to the total ion content of each water type. Each water sample is represented by a point on the diagram. Percentage scales along the sides of the trilinear diagrams indicate the relative concentration (in milliequivalents per liter) of each major ion. Cations are shown in the left triangle and anions in the right triangle. The central diamond integrates the data for both cations and anions.

The South Delta Islands (Figure 3a) drainage samples show a mixed calcium-magnesium-sodium cation reflecting the blend of lower watershed San Joaquin River source and local agricultural return flows. Over 50 percent of these samples show a chloride dominated anion. This contrasts with the Panoche Fan diagram (Figure 3b) which shows drainage with a sodium sulfate composition (Chilcott et al., 1988). The agricultural drainage water from the western portion of Stanislaus County (Figure 3c) is similar to that of the South Delta Islands in that it shows a blended water of mixed chemical character, but it does not compare to the more strongly chloride dominated water of the Delta Islands.

The chloride to sulfate ratio (in milliequivalents per liter) for water from the South Delta Island drains suggest a somewhat equivalent relationship with chloride slightly to moderately dominant. The median ratio value was found to be 1.5 with over 60 percent of the ratios falling between one and two. This compares to the ratios of the Panoche Fan area with a median value of 0.5 and with 90 percent of the ratios below one. The western portion of Stanislaus County had a median value of one and with only 40 percent of the ratios between one and two. The higher ratio values of chloride to sulfate in the South Delta area are expected due to the proximity to sea water and its influence on fresh water conditions.

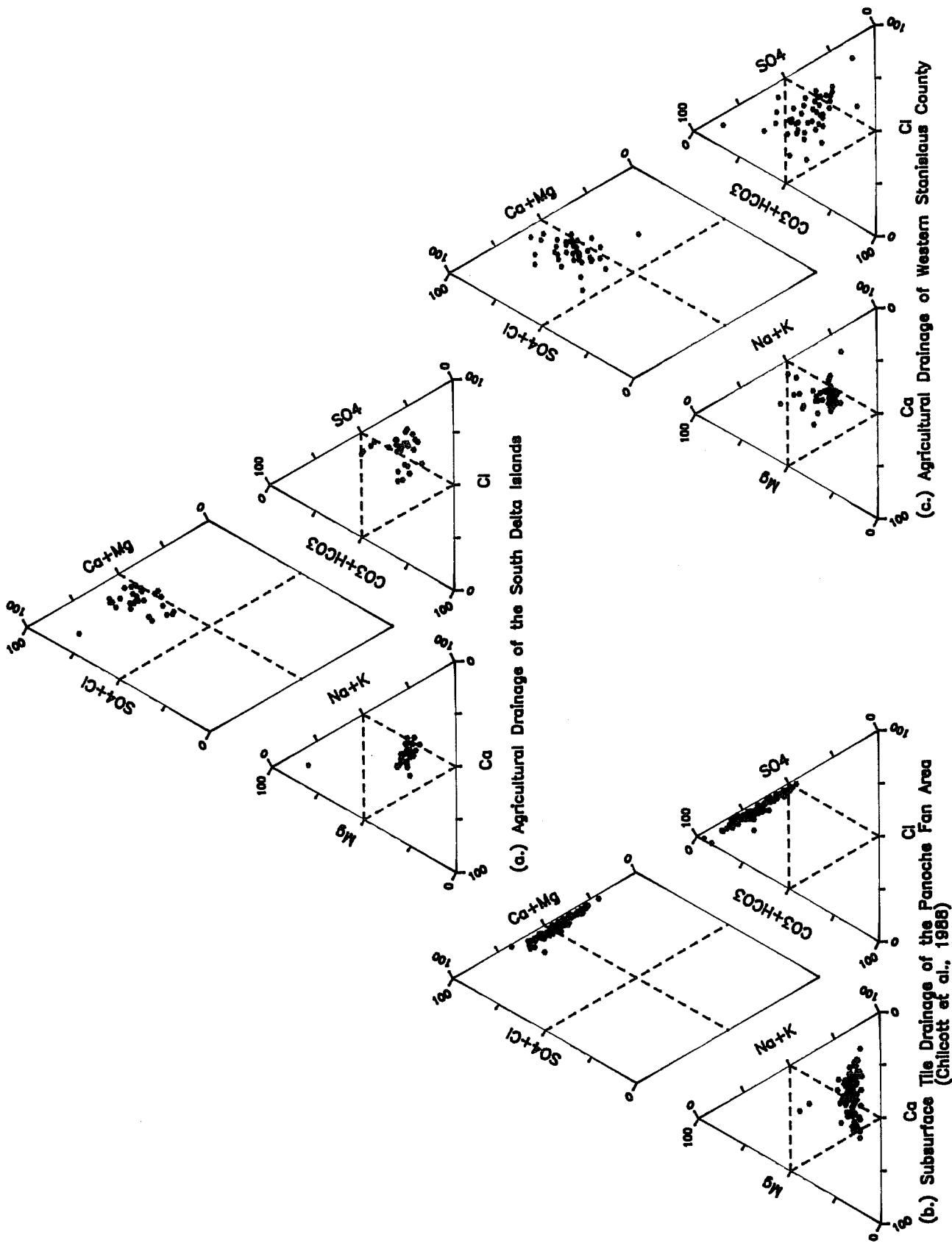


Figure 3. Chemical Composition of Water Samples for Selected Areas.

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APPENDIX A

Appendix A. Water quality data for agricultural drainage that flows from selected Delta Islands into the San Joaquin River and Delta Waterways.

Index # & Location	Date	Time	Temp °F	pH	EC umhos/cm	Se µg/L	Mo µg/L	Cu µg/L	Cr µg/L	Ni µg/L	Pb µg/L	Zn µg/L	Hg µg/L	B mg/L	Cl mg/L	SO4 mg/L	Ca mg/L	Mg mg/L	Na mg/L	K mg/L	Total mg/L	Alk mg/L	Hard mg/L	TDS mg/L
1 Deuel Vocational Institute SJC721	21-Jan-86		56	8.1	2500	1.0	<5	3	<1	8	<5	3	<0.5	1.4	530	530	73	33	90	2.3	0	180	180	
	22-Apr-86	0945	60		1100	1.0	<5	5	<1	8	<5	15	<0.5	0.26	150	210	160	100	180	0	180	180	670	
	28-Jul-86	0830	64		1200	1.6	<5	740	2.1		<5	1	<0.5	0.84	100	34	100	42	80	90	6	170	176	
	8-May-87	0940	68		68	7.2	700	2.5			<5	14	<0.5	0.42	80	79	360	280						
	22-Jul-87	67	7.1		2050	1.2																		
2 Paradise Mutual at Paradise Cut SJC720	23-Sep-87	63	7.1																					
	22-Apr-86	1000	65	7.7	450	<1	<5	5	1	<1	<5	5	<0.5	0.20	46	52	19	12	36	5.2	0	72	72	
	28-Jul-86	0850	69		1600	0.6	<5	1	<1	3	<5	4	<0.5	0.87	220	240	200	140	240	200	180	180	670	
	9-Sep-86	0940	67		1300	0.8	<5	3	<1		<5	4	<0.5	0.73	170	200	140	100	180	120	120	120	670	
	8-May-87	0925	71		1510	1.3																		
	22-Jul-87	74	7.1		1100	2.1																		
	23-Sep-87	62	7.0		2150	0.8																		
3 Pescadero RD to Tom Paine Slough SJC722	21-Jan-86	1230	72	8.0	3200	3.0	9	15	<1	7	23	<5	30	<0.5	3.1	610	670	160	100	350	9	16	0	
	22-Apr-86	0925	64		1300	1.5	<5	4	<1	2	7	<5	13	<0.5	2.7	630	600	200	140	220	200	236	236	
	9-Sep-86	1000	62		1300	1.1	5	6	2	7	<5	13	<0.5	1.1	220	210	140	100	220	210	190	190		
	12-Mar-87	1135	65	7.0	3570	2.1																		
	8-May-87	1005	70		1780	2.1																		
	22-Jul-87	69	7.4		1600	2.3																		
	23-Sep-87	62	7.4		1850	2.2																		
4 RD107/RD2058 Disch to Tom Paine Slough SJC723	21-Jan-86	1255	81	7.8	3800	2.0	<5	14	3	<1	20	<5	30	<0.5	4.0	700	380	160	100	480	160	0	260	
	22-Apr-86	0945	67		4500	3.0	<5	1	3	4	8	<5	8	<0.5	3.7	650	300	250	200	350	170	0	316	
	28-Jul-86	1020	68		1300	1.3	<5	6	4	8	<5	18	<0.5	2.0	210	200	140	100	220	210	190	190		
	9-Sep-86	1025	69		2680	6.2																		
	8-May-87	1210	74	6.7	1100	2.1																		
	22-Jul-87	74	6.7		1100	2.1																		
	23-Sep-87	59	7.2		2600	4.4																		
5 Fabian Tract South #2 SJC708	22-Jan-86	56	7.3		1900	<1	2600	2.0	16	18	4	21	<5	7	<0.5	0.70	280	520	150	100	0	150	150	
	6-May-86	1200	58	8.1	1400	0.5	<5	<1	<1	<1	<5	5	<0.5	0.77	350	600	270	190	320	160	160	160	1700	
	28-Jul-86	1300	67		2200	0.8	10	<1	<1	<1	<5	3	<0.5	0.90	270	200	140	100	220	210	170	170		
	19-Sep-86	1305	63		1410	1.4																		
	12-Mar-87	1400	61		1220	1.0																		
	8-May-87	1400	65		1200	1.5																		
	22-Jul-87	75	6.8		1200	1.5																		
	23-Sep-87	69	7.1		2350	0.6																		
6 Fabian Tract South #1 SJC707	22-Jan-86	53	7.3		2600	1.0	30	23	12	31	<5	26	<0.5	0.40	550	360	230	150	510	1.1	0	250	250	
	6-May-86	1120	60	8.2	4100	6.0	<5	1	<1	5	<5	3	<0.5	0.86	600	960	460	310	450	330	300	300	2800	
	28-Jul-86	1245	68		2600	1.1	<5	14	1	<1	<5	1	<0.5	0.55	270	600	420	270	420	340	300	300		
	9-Sep-86	1250	68		2700	0.9	14	1	<1	<1	<5	1	<0.5	0.45	510	510	340	240	360	1.1	0	240	240	
	19-Mar-87	1520	64		2520	1.9																		
	8-May-87	1420	68	6.3	2710	3.4																		
	22-Jul-87	68	6.3		2600	3.1																		
	23-Sep-87	69	7.2		2400	1.9																		

Appendix A.

Continued...

Index # & Location	Date	Time	Temp °F	pH	EC umhos/cm	Se µg/L	Mo µg/L	Cu µg/L	Cr µg/L	Ni µg/L	Pb µg/L	Zn µg/L	Hg µg/L	B µg/L	Cl mg/L	SO4 mg/L	Ca mg/L	Mg mg/L	Na mg/L	K mg/L	CO3 mg/L	HCO3 mg/L	Total Alk mg/L	Hard mg/L	TDS mg/L
7 Fabian Tract East SJC706	22-Jan-86	51	7.5	920	<1	7	6	<1	8	<5	5	<0.5	0.20	180	120	160	0	140	140	140	140	140	140	770	
	6-May-86	1055	8.3	1400	<1	8	6	<1	8	<5	4	<0.5	0.22	270	160	70	48	180	1.6	0	160	160	370	370	
	28-Jul-86	1225	68	940	0.8	<5	2	<1	2	<5	7	<0.5	0.10	35	91	120	190	47	47	170	170	180	180	180	
	9-Sep-86	1240	63	1000	0.2	<5	2	<1	2	<5	7	<0.5	0.13	250	170	120	120	120	120	120	120	120	120	120	
	12-Mar-87	1320	59	6.4	1140	0.9	1140	0.3	1020	0.3	1020	0.3	0.20	170	120	120	120	120	120	120	120	120	120	120	
	8-May-87	1235	67	86	7.2	950	2.5	86	7.2	950	2.5	0.56	0.21	210	86	120	120	120	120	120	120	120	120	120	120
	22-Jul-87	84	6.9	1200	0.3	84	6.9	1200	0.3	84	6.9	0.21	210	86	120	120	120	120	120	120	120	120	120	120	
8 RD1007 @ Old River East of Tracy SJC729	29-Apr-86	54	8.2	2100	<1	7	6	9	11	6	22	<0.5	0.74	400	300	120	75	200	4.5	0	230	230	630	1300	
	28-Jul-86	74	1100	2.0	5	3	2	1	5	5	4	<0.5	0.57	140	160	160	160	160	160	160	160	160	160	160	
	9-Sep-86	69	2300	1.2	10	2	1	1	1	1	1	<0.5	0.5	1.3	400	320	320	320	320	320	320	320	320	320	320
	19-Mar-87	1535	64	3880	2.2	1210	2.0	1210	2.0	1210	2.0	0.45	180	180	180	180	180	180	180	180	180	180	180		
	8-May-87	1220	76	7.3	1600	1.7	1600	1.7	1600	1.7	1600	1.7	0.90	190	200	200	200	200	200	200	200	200	200	200	
	22-Jul-87	78	7.4	2250	1.8	78	7.4	2250	1.8	78	7.4	1.1	380	340	340	340	340	340	340	340	340	340	340	340	
9 Pescadero RD Pumps North of MacArthur SJJC727	22-Apr-86	68	8.0	2400	<1	8	3	3	10	<5	6	<0.5	1.3	460	360	160	74	260	6.4	0	230	230	730	1500	
	28-Jul-86	1020	68	1200	1.4	<5	5	1	9	<5	18	<0.5	0.68	140	210	160	160	160	160	160	160	160	160	160	
	9-Sep-86	1050	66	1400	0.6	<5	3	1	<5	<5	9	<0.5	0.33	270	140	140	140	140	140	140	140	140	140	140	
	12-Mar-86	1210	62	6.5	1850	0.1	1850	0.1	1850	0.1	1850	0.1	0.25	450	450	450	450	450	450	450	450	450	450	450	
	8-May-87	1100	74	1810	1.7	1810	1.7	1810	1.7	1810	1.7	0.44	360	360	360	360	360	360	360	360	360	360	360		
	22-Jul-87	71	6.6	1700	1.9	71	6.6	1700	1.9	71	6.6	0.94	110	96	96	96	96	96	96	96	96	96	96	96	
	23-Sep-87	63	7.2	1250	1.4	63	7.2	1250	1.4	63	7.2	0.65	150	150	150	150	150	150	150	150	150	150	150	150	
10 Pump West of Tom Paine & North of Delta Ave SJJC726	22-Apr-86	71	8.0	2600	<1	<5	3	3	3	<5	10	5	<0.5	1.8	590	450	140	76	300	7.7	16	220	236	770	1700
	28-Jul-86	1030	70	1100	1.4	<5	5	2	10	<5	18	<0.5	0.8	130	160	160	160	160	160	160	160	160	160	160	
	9-Sep-86	1100	66	1200	0.5	<5	3	1	<5	<5	6	<0.5	0.34	250	130	130	130	130	130	130	130	130	130	130	
	12-Mar-87	1230	63	6.4	1350	0.4	1350	0.4	1350	0.4	1350	0.4	0.18	300	300	300	300	300	300	300	300	300	300	300	
	8-May-87	1120	74	1600	2.4	1600	2.4	1600	2.4	1600	2.4	0.71	280	280	280	280	280	280	280	280	280	280	280	280	
	22-Jul-87	72	6.9	1500	1.9	72	6.9	1500	1.9	72	6.9	0.94	190	180	180	180	180	180	180	180	180	180	180	180	
	23-Sep-87	65	7.1	1450	1.8	65	7.1	1450	1.8	65	7.1	0.88	190	190	190	190	190	190	190	190	190	190	190	190	
11 Pescadero RD North of Delta Ave SJJC725	21-Jan-86	71	8.0	2900	<1	10	4	3	6	<5	9	<0.5	0.30	460	210	190	87	309	7.9	0	170	170	170	170	
	22-Apr-86	1500	71	8.0	2900	<1	10	4	3	14	32	<0.5	1.8	630	470	190	190	190	190	190	190	190	190	190	
	28-Jul-86	1050	67	1600	1.6	<5	8	2	14	<5	7	<0.5	0.87	250	190	190	190	190	190	190	190	190	190	190	
	9-Sep-86	1115	67	1400	0.9	<5	3	1	<5	<5	7	<0.5	0.25	360	360	360	360	360	360	360	360	360	360	360	
	19-Mar-87	1605	62	1670	0.5	1670	0.5	1670	0.5	1670	0.5	0.75	250	250	250	250	250	250	250	250	250	250	250		
	8-May-87	1135	72	1500	1.9	1500	1.9	1500	1.9	1500	1.9	0.99	190	190	190	190	190	190	190	190	190	190	190		
	22-Jul-87	71	6.9	1500	1.9	71	6.9	1500	1.9	71	6.9	0.85	210	180	180	180	180	180	180	180	180	180	180	180	
	23-Sep-87	66	7.1	1450	1.7	66	7.1	1450	1.7	66	7.1	0.85	210	180	180	180	180	180	180	180	180	180	180	180	
12 Stewart Tract SJJC724	21-Jan-86	52	7.6	1600	<1	<5	2	3	<5	6	6	<0.5	1.8	360	160	160	160	160	160	160	160	160	160	160	
	22-Jan-86	68	8.2	2000	<1	<5	5	1	<1	<5	12	<0.5	0.19	440	210	150	55	140	2.8	0	180	180	180	180	
	22-Apr-86	1345	69	1600	0.9	<5	6	6	6	7	<5	<0.5	0.56	170	170	170	170	170	170	170	170	170	170	170	
	28-Jul-86	1105	64	710	1.1	<5	6	6	6	7	<5	<0.5	0.18	480	100	100	100	100	100	100	100	100	100	100	
	9-Sep-86	1130	64	2090	0.2	1170	2.0	1170	2.0	1170	2.0	0.29	210	210	210	210	210	210	210	210	210	210	210		
	19-Mar-87	1625	58	1400	1.8	1400	1.8	1400	1.8	1400	1.8	0.48	200	140	140	140	140	140	140	140	140	140	140		
	8-May-87	1150	72	6.5	2300	0.4	2300	0.4	2300	0.4	2300	0.4	0.18	560	180	180	180	180	180	180	180	180	180	180	
	22-Jul-87	72	6.5	2300	0.4	72	6.5	2300	0.4	72	6.5	0.18	560	180	180	180	180	180	180	180	180	180	180	180	
	23-Sep-87	66	7.3	2300	0.4	66	7.3	2300	0.4	66	7.3	0.18	560	180	180	180	180	180	180	180	180	180	180	180	

Appendix A. Continued...

Index # & Location	Date	Time	Temp °F	pH	EC umhos/cm	Se µg/L	Cu µg/L	Cr µg/L	Ni µg/L	Pb µg/L	Zn µg/L	Hg µg/L	B mg/L	C mg/L	SO4 mg/L	Ca mg/L	Mg mg/L	Na mg/L	K mg/L	CO3 mg/L	HCO3 mg/L	Total Alk mg/L	Hard mg/L	TDS mg/L
13 Union Island RD #2, Old River #1	SJC733																							
29-Apr-86	1115	60	8.0	2700	<1	8	2	5	<5	5	7	4	<0.5	0.29	600	340	160	93	230	4.7	0	200	110	
29-Jul-86	1000	67		780	1.4	<5	4	<1	2	5	<5	6	<0.5	0.52	100	110	<0.5	9	<5	6	0.39	100	140	
9-Sep-86	1530	74		830	0.6	<5	3	2	5	<5	6	<0.5	0.53	130	130	96	100						110	
22-Jul-87	86	74		980	2.4																		96	
14 Union Island RD #2, Old River #2	SJC734																							
29-Apr-86	1130	61	8.0	2500	<1	5	2	3	1	6	<5	6	<0.5	0.20	410	540	170	94	210	3.4	0	140	140	
29-Jul-86	1005	71		690	1.5	<5	5	4	3	6	<5	9	<0.5	0.57	88	110	68	90					110	
9-Sep-86	1510	75		620	0.7	<5	4																96	
16-Mar-87	1340	60	6.8	670	1.1																			
8-May-87	1125	73	7.7	743	2.6																			
22-Jul-87	86	7.2		790	3.1																			
23-Sep-87	64			1050	0.8																			
15 Union Island RD #2, Old River #3	SJC735																							
29-Apr-86	1145	58	8.2	1800	<1	<5	1	<1	<1	<5	<5	2	<0.5	0.07	390	180	110	64	170	2.7	0	200	590	
29-Jul-86	1020	66		1000	0.7	<5	1	<1	<1	<5	<5	2	<0.5	0.44	170	91						180		
9-Sep-86	1520	70		780	0.5	<5	15	25	28	8	50	<0.5	0.35	100	46								160	
16-Mar-87	1320	60	6.3	817	0.7																			
8-May-87	1110	72	7.4	750	1.0																			
22-Jul-87	76	7.2		960	1.0																			
23-Sep-87	71			1360	4.9																			
16 Union Island RD #2, Old River #4	SJC736																							
29-Apr-86	1200	53	7.8	350	<1	<5	3	4	<5	<5	<5	14	<0.5	0.07	40	30	19	8	28	1.8	0	52	130	
29-Jul-86	1030	68		1200	1.7	<5	5	<1	<1	<8	<5	15	<0.5	0.35	200	140						150		
9-Sep-86	1545	70		690	1.1	<5	8	9	10	<5	23	<5	0.26	0.26	72	70						92		
16-Mar-87	1355	68	7.2	1930	1.2																			
8-May-87	1140	71	8.0	2550	1.4																			
22-Jul-87	85	7.4		900	2.7																			
23-Sep-87	67			1250	0.8																			
17 Union Island RD #2, Middle River #1	SJC737																							
29-Apr-86	1230	63	8.0	2100	<1	<5	1	1	<5	<5	<5	3	<0.5	0.08	470	250	120	68	140	1.8	0	140	170	
29-Jul-86	1100	76		740	1.7	<5	4	<1	<1	<5	<5	8	<0.5	0.46	100	110						120		
9-Sep-86	1605	72		1100	0.7	<5	2	1	<5	<5	<5	3	<0.5	0.16	190	110						100		
16-Mar-87	1415	63	7.3	2440	0.6																			
8-May-87	1200	75	8.4	737	2.7																			
23-Jul-87	68	7.4		800	2.7																			
23-Sep-87	64			3100	0.7																			
18 Union Island RD #2, South #3	SJC732																							
29-Apr-86	1045	58	8.1	2100	<1	<5	2	4	9	6	<5	8	<0.5	0.17	470	260	130	76	160	1.4	0	150	150	
29-Jul-86	0920	68		960	1.6	<5	5	<1	<6	7	<5	15	<0.5	0.38	150	130						140		
9-Sep-86	1450	72		960	0.5	<5	5	5	6	6	<5	13	<0.5	0.27	140	120						120		
16-Mar-87	1220	56	6.7	1580	0.6																			
8-May-87	1050	70	7.7	864	2.3																			
22-Jul-87	85	7.8		900	2.4																			
23-Sep-87	66			1300	0.8																			
19 Union Island RD#2, South #1	SJC730																							
28-Apr-86	0935	62	7.9	810	<1	<5	2	2	<5	<5	6	<0.5	0.12	130	96	45	240	60	2.8	0	72	72	290	
29-Jul-86	0905	64		840	1.3	<5	6	<1	<5	5	<5	9	<0.5	0.43	120	110						140		
9-Sep-86	1440	69		1200	0.2	<5	2	1	<1	<5	4	<0.5	0.18	210	57							240		
16-Mar-87	1235	58	6.9	1120	0.4																			
8-May-87	1030	69	7.8	1180	0.5																			
22-Jul-87	71	7.0		950	1.5																			
23-Sep-87	67			950	1.0																			

Appendix A. Continued...

Index # & Location	Date	Time	Temp °F	PH umhos/cm	EC	Se µg/L	Mo µg/L	Cu µg/L	Cr µg/L	Ni µg/L	Pb µg/L	Zn µg/L	Hg µg/L	B mg/L	Cl mg/L	SO4 mg/L	Ca mg/L	Mg mg/L	Na mg/L	K mg/L	CO3 mg/L	Total Alk mg/L	Hard mg/L	TDS mg/L		
20 Union Island RD #2, South #2 SJC731	28-Apr-86	1015	56	7.8	770	<1	<5	5	6	8	<5	15	<0.5	0.12	130	84	46	22	61	2	0	68	68	240		
	29-Jul-86	0845	64	620	0.3	<5	2	<1	<1	4	<5	5	<0.5	0.29	92	66	270	150	120	0.22	270	130	440			
	9-Sep-86	1425	65	6.4	667	0.4	1	1	1	4	<5	4	<0.5	0.18	120	10	0.35	140	110	0.35	110	92	88			
16-Mar-87	1245	70	71	7.9	791	3.2																				
8-May-87	1035	69	7.0	930	0.7																					
22-Jul-87	68	7.0	800	0.4																						
23-Sep-87	65																									
21 Fabian Tract North #3 SJC745	6-May-86	1300	65	7.6	1050	<1	6	6	<1	6	<5	7	<0.5	0.22	170	140	60	33	150	1.9	0	110	110	483		
	28-Jul-86	1355	82	1300	1.9																					
	9-Sep-86	1350	72	1100	0.2																					
12-Mar-87	1510	69	6.6	1120	0.7																					
8-May-87	1255	72	718	2.0	750	0.4																				
22-Jul-87	80	7.2	750	0.5																						
23-Sep-87	65	7.0	750	0.5																						
8-May-87	1330	72	3230	1.0																						
23-Sep-87	68	7.3	800	0.5																						
22 Union Island RD #1, South #1 SJC711	22-Jan-86	50	7.5	820	1.0	<1	10	7	<1	5	<5	7	<0.5	0.50	130	140	200	150	75	42	135	1.6	0	100	100	
	6-May-86	1315	60	8.0	1180	<1	880	1.5	5	6	2	9	<5	18	<0.5	0.15	200	150	100	120	0.26	100	120	140	557	
	28-Jul-86	1420	75	870	0.6																					
	9-Sep-86	1405	70	870	0.6																					
12-Mar-87	1530	60	6.7	1250	0.7																					
8-May-87	1300	68	7.6	1420	1.3																					
22-Jul-87	77	7.1	1200	0.7																						
23-Sep-87	67	7.1	1200	0.7																						
23 Fabian Tract North #2 SJC710	22-Jan-86	56	7.5	1100	<1	8	2	2	<1	6	<5	6	<0.5	0.30	200	150	170	120	89	50	150	2	0	140	140	
	6-May-86	1245	60	7.9	1400	<1	8	6	1	<5	5	<5	5	<0.5	0.25	240	170	180	120	260	100	91	150	100	150	600
	28-Jul-86	1330	74	1400	0.9																					
	9-Sep-86	1330	72	720	0.8																					
12-Mar-87	1450	62	6.7	1100	0.7																					
8-May-87	1320	75	969	2.0	1000	2.1																				
22-Jul-87	75	6.8	1000	2.1																						
23-Sep-87	69	6.9	1300	0.6																						
24 Fabian Tract North #1 SJC709	22-Jan-86	56	7.6	1900	1.0	<1	15	17	<1	9	<5	6	<0.5	0.30	240	240	380	450	140	78	260	2	0	140	140	
	6-May-87	1235	60	8.0	2200	<1	0.7	10	2	<1	5	<5	<5	<0.5	0.66	140	140	180	440	0.23	64	65	260	100	1400	
	28-Jul-86	1320	74	2600	0.5																					
	9-Sep-86	1320	70	550	0.5																					
12-Mar-87	1435	61	6.7	1210	0.9																					
8-May-87	1345	75	1600	2.0	1200	2.1																				
22-Jul-87	82	7.2	1200	2.1																						
23-Sep-87	65	7.1	1450	1.1																						
25 Union Island RD #1, Southwest #1 SJC713	22-Jan-86	55	7.5	1400	<1	11	5	3	1	11	<5	16	0.5	0.70	230	280	79	130	8	130	138	138	64	64		
	23-Jul-86	1530	73	600	1.0																					
	10-Sep-86	1110	67	550	0.4																					
16-Mar-87	1725	60	6.9	1410	0.7																					
8-May-87	1615	82	1090	1.3																						
22-Jul-87	76	7.0	740	2.1																						
23-Sep-87	71	8.3	1200	1.1																						

Appendix A. Continued...

Index # & Location	Date	Time	Temp °F	pH	EC umhos/cm	Se µg/L	Cu µg/L	Cr µg/L	Ni µg/L	Pb µg/L	Zn µg/L	Hg µg/L	B mg/L	Cl mg/L	SO4 mg/L	Ca mg/L	Mg mg/L	Na mg/L	K mg/L	CO3 mg/L	HCO3 mg/L	Total Alk mg/L	Hard mg/L	TDS mg/L
26 Union Island RD #1, West	SJC712		54	6.8	1700	<1	13	15	12	19	<5	34	0.8	0.90	270	400	96	87	0	100	100	52	80	
22-Jan-86	10550	90	66	6.4	900	1.2	8	6	5	9	<5	15	<0.5	0.34	69	76	220	230	0.10	110	100	52	80	
29-Jul-86	10555	64	64	6.4	1450	0.9								0.79										
10-Sep-86	17055	64	64	6.4	1520	1.5																		
16-Mar-87	1540	77	78	7.0	810	1.0																		
8-May-87	1205	72	8.5	7.0	1000	0.6																		
23-Jul-87	68																							
27 Union Island RD #2, Middle River #2	SJC738																							
28 Union Island RD #2, Middle River #3	SJC739																							
29-Apr-86	1320	65	8.0	6.8	460	<1	<5	1	1	<5	<5	2	<0.5	0.13	50	49	23	12	41	1.8	0	76	120	250
29-Jul-86	1130	73	62	7.4	680	2.1	<5	3	<1	<5	9	<0.5	0.41	84	97	9	80	9	110	110	110	110	250	
16-Mar-87	1450	62	72	8.5	621	0.9																		
8-May-87	1205	72	8.5	6.5	672	1.3																		
23-Jul-87	68																							
29 Union Island RD #2, Middle River #4	SJC740																							
29-Apr-86	1420	67	7.9	7.9	730	<1	<5	9	11	14	<5	26	<0.5	0.23	120	63	37	15	74	2	0	84	160	400
29-Jul-86	1200	67	65	7.0	1400	0.4	7	1	<1	<5	5	4	4	<0.5	0.34	290	96	400	100	100	100	170	170	
10-Sep-86	1130	65	65	7.0	1100	0.4	<5	5	4	6	<5	11	<0.5	0.18	350	79	63	63	63	63	63	85	100	
12-Mar-87	1630	59	6.7	6.0	1680	0.6																		
8-May-87	1220	71	8.0	1440	1.9																			
23-Jul-87	71																							
29 Union Island RD #2, Middle River #7	SJC747																							
29-Apr-86	1420	67	7.3	7.3	480	<1	6	3	1	<5	<5	3	<0.5	0.16	63	49	26	11	39	7.5	0	64	130	260
29-Jul-86	1355	71	65	7.3	380	1.0	9	5	1	8	<5	12	<0.5	0.14	45	41	10	10	10	10	10	68	100	
10-Sep-86	0905	65	65	6.5	470	0.4	5	6	3	13	<5	13	<0.5	0.23	400	100	58	58	58	58	58	85	100	
16-Mar-87	1500	67	6.3	7.5	755	0.7																		
8-May-87	0925	69	6.6	6.7	670	0.6																		
23-Jul-87	66	7.4	66	7.4	450	0.6																		
23-Sep-87	69																							
31 Union Island Northeast #1	SJC741																							
21-Jan-86	1355	71	7.3	7.3	480	<1	6	3	1	<5	<5	3	<0.5	0.50	220	100	110	61	33	82	22	8	180	188
29-Jul-86	1355	71	7.3	7.3	380	1.0	9	5	1	<5	<5	8	<0.5	0.12	150	110	61	33	82	22	8	160	160	
10-Sep-86	0905	65	65	6.5	470	0.4	5	6	3	13	<5	13	<0.5	0.14	45	41	10	10	10	10	10	68	100	
16-Mar-87	1500	67	6.3	7.5	755	0.7																		
8-May-87	0925	69	6.6	6.7	670	0.6																		
23-Jul-87	66	7.4	66	7.4	450	0.6																		
23-Sep-87	67																							
31 Union Island Northeast #2	SJC742																							
21-Jan-86	1430	67	8.0	1000	<1	<5	4	4	9	<5	<5	8	<0.5	0.50	220	100	110	61	33	82	22	8	180	188
29-Apr-86	0920	64	64	450	0.3	<5	2	2	<5	<5	<5	6	<0.5	0.14	150	110	61	33	82	22	8	160	160	
16-Mar-87	1520	65	6.5	507	0.6																			
8-May-87	0935	67	7.0	611	0.2																			
23-Jul-87	65	7.6	540	0.4																				
23-Sep-87	67																							
32 The Pocket RD24, Southeast	SJC744																							
21-Jan-86	1615	68	8.0	1100	<1	7	5	3	5	<5	10	<0.5	0.10	73	150	110	61	33	82	22	8	190	198	
29-Apr-86	1320	79	320	0.7	<5	16	17	29	8	<5	60	<0.5	0.21	190	87	31	31	31	31	31	200	200		
10-Sep-86	0845	62	670	0.2	<5	2	1	<5	5	<5	5	<0.5	0.10	150	96	19	19	19	19	19	60	60		
30-Mar-87	1250	67	916	0.2	1.1	916	0.2	1.1	1.1	1.1	1.1	0.10	0.10	150	150	150	150	150	150	150	150	150		
8-May-87	0910	71	6.3	596	1.4																			
23-Jul-87	69	420	0.9	900	0.8																			
23-Sep-87	64																							

Appendix A. Continued...

Index # & Location	Date	Time	Temp °F	pH	EC umhos/cm	Se µg/L	Cu µg/L	Cr µg/L	Ni µg/L	Pb µg/L	Zn µg/L	Hg µg/L	B µg/L	Cl µg/L	SO4 µg/L	Ca µg/L	Mg µg/L	Na µg/L	K µg/L	CO3 mg/L	Total Alk mg/L	Hard mg/L	TDS mg/L
33 Union Island RD #2, Northwest SJC743	21-Jan-86	69	7.9	1600	<1	5	9	9	12	<5	23	<0.5	0.30	420	140	50	23	72	4.6	0	160	160	
	28-Apr-86	1455	78	850	<1	5	9	6	4	<5	20	<0.5	0.21	150	90	57	0.16	80	0	80	80		
	29-Jul-86	1420	66	560	0.5	3	7	4	1	6	<5	7	<0.5	0.14	120	62	0.25	910	110	76	76		
	10-Sep-86	0935	66	450	0.3	280	0.4	7	4	1	6	<5	0.14	170	170	0.17	120	120	96	96			
	19-Mar-87	1220	58	954	0.7	782	1.5	1	1	1	1	1	0.14	480	28	0.12	150	150	64	64			
	8-May-87	1000	71	1090	1.1	400	1.1	1	1	1	1	1	0.14	470	47	0.14	150	150	100	100			
	23-Jul-87	66	74	700	0.6	460	0.4	1	1	1	1	1	0.14	470	47	0.14	150	150	64	64			
34 Drexler Tract West SJC704	21-Jan-86	54	7.1	1400	<1	9	2	<1	5	<5	5	<0.5	0.30	290	240	0.14	68	83	0	120	120		
	30-Jul-86	0955	70	860	0.1	380	0.3	<5	1	3	<5	3	<0.5	0.22	160	130	0.22	170	170	84	84		
	10-Sep-86	1400	68	580	0.7	954	1.1	1	1	1	1	1	0.24	170	170	0.17	120	120	120	120			
	19-Mar-87	1105	58	1090	1.1	400	1.1	1	1	1	1	1	0.17	480	28	0.12	150	150	64	64			
	8-May-87	1320	73	1090	1.1	460	0.4	1	1	1	1	1	0.17	480	28	0.12	150	150	64	64			
	23-Jul-87	77	500	500	0.5	460	0.4	1	1	1	1	1	0.17	480	28	0.12	150	150	64	64			
35 Union Island RD #1, North #2 SJC718	22-Jan-86	51	6.9	1200	<1	350	0.3	6	2	1	<5	7	<0.5	0.20	140	300	0.16	36	46	0	84		
	28-Jul-86	1505	77	480	0.7	515	0.5	6	4	10	<5	15	<0.5	0.14	63	110	0.09	100	100	84	84		
	10-Sep-86	1015	62	810	1.2	510	0.5	5	1	1	<5	15	<0.5	0.14	82	82	0.11	70	70	86	86		
	16-Mar-87	1605	68	6.6	810	1.2	510	0.5	5	1	<5	15	<0.5	0.14	82	82	0.11	70	70	86	86		
	8-May-87	1455	76	510	0.5	481	0.5	5	1	1	<5	15	<0.5	0.14	82	82	0.11	70	70	86	86		
	23-Jul-87	77	510	510	0.5	481	0.5	5	1	1	<5	15	<0.5	0.14	82	82	0.11	70	70	86	86		
36 Union Island RD #1, North #1 SJC716	23-Sep-87	73	74	600	0.7	460	0.5	5	1	<1	<5	5	<0.5	0.10	71	63	0.12	45	45	<1	85		
	22-Jan-86	56	7.1	500	<1	400	0.1	9	1	<1	<5	5	<0.5	0.10	71	63	0.12	45	45	0	84		
	28-Jul-86	1455	74	400	0.1	515	0.3	5	2	<1	<5	5	<0.5	0.10	71	63	0.12	45	45	0	84		
	10-Sep-86	1005	68	710	0.7	515	0.6	5	4	10	<5	15	<0.5	0.14	41	28	0.09	96	96	84	84		
	16-Mar-87	1555	62	6.6	515	0.6	510	0.5	5	1	<5	15	<0.5	0.13	52	52	0.10	40	40	84	84		
	8-May-87	1445	74	481	0.5	370	0.5	5	1	1	<5	15	<0.5	0.11	40	19	0.10	40	40	84	84		
	23-Jul-87	70	510	450	0.5	481	0.5	5	1	1	<5	15	<0.5	0.11	40	19	0.10	40	40	84	84		
37 Union Island RD #1, Northwest #1 SJC715	23-Sep-87	72	82	72	1.5	460	0.5	5	1	<1	<5	5	<0.5	0.10	71	63	0.12	45	45	<1	90		
	22-Jan-86	56	7.3	1800	<1	400	0.1	9	1	<1	<5	5	<0.5	0.10	71	63	0.12	45	45	0	84		
	28-Jul-86	1610	85	900	2.0	12	20	13	27	5	70	<0.5	0.48	120	140	0.48	120	140	68	68			
	10-Sep-86	1030	65	610	0.9	6	7	6	10	18	<5	18	<0.5	0.39	83	95	0.39	83	95	76	76		
	16-Mar-87	1630	64	2010	0.7	1740	1.1	1	1	1	1	1	<0.5	0.87	330	330	0.87	330	330	92	92		
	10-May-87	1515	78	950	3.1	510	1.7	1	1	1	1	1	<0.5	0.42	130	130	0.42	130	130	84	84		
	23-Jul-87	78	940	2.2	510	1.7	1	1	1	1	1	1	<0.5	0.51	120	140	0.51	120	140	71	71		
	23-Sep-87	72	7.3	1100	1.5	460	0.5	5	1	<1	<5	5	<0.5	0.10	71	63	0.12	45	45	<1	71		
38 Union Island #1 Northwest #2 SJC746	29-Jul-86	1625	84	540	1.5	9	19	17	36	6	90	<0.5	0.45	69	62	0.45	69	62	40	40			
	10-Sep-86	1045	64	630	0.5	8	10	9	17	5	29	<0.5	0.65	130	110	0.65	130	110	120	120			
	16-Mar-87	1645	66	6.8	1740	1.1	1	1	1	1	1	1	<0.5	1.3	340	340	1.3	340	340	92	92		
	8-May-87	1525	76	898	2.0	1970	0.5	1	1	1	1	1	<0.5	0.50	120	140	0.50	120	140	84	84		
	23-Jul-87	85	510	1.7	510	1.7	1	1	1	1	1	1	<0.5	0.23	90	100	0.23	90	100	71	71		
	23-Sep-87	73	7.2	750	0.8	460	0.5	5	1	<1	<5	5	<0.5	0.23	90	100	0.23	90	100	<1	80		
39 Byron Tract East CCC701	21-Jan-86	52	7.2	2800	<1	1400	0.6	6	4	23	<5	25	<0.5	3.5	520	240	2.8	220	220	40	40		
	30-Jul-86	1025	72	1400	0.4	5	7	4	13	13	<5	25	<0.5	2.0	270	160	2.0	270	160	120	120		
	10-Sep-86	1645	66	1400	0.4	1400	0.4	1	1	1	1	1	<0.5	2.7	160	160	2.7	160	160	140	140		
	16-Mar-87	1145	56	5.2	1970	0.5	1	1	1	1	1	1	<0.5	3.2	200	130	3.2	200	130	160	160		
	19-Mar-87	1145	75	7.6	1070	1.6	1	1	1	1	1	1	<0.5	2.2	280	160	2.2	280	160	76	76		
	8-May-87	1515	74	1300	0.8	1550	0.5	1	1	1	1	1	<0.5	2.4	280	160	2.4	280	160	154	154		
	23-Jul-87	71	1550	0.5	1550	0.5	1	1	1	1	1	1	<0.5	2.4	280	160	2.4	280	160	76	76		

Appendix A. Continued...

Index # & Location	Date	Time	Temp °F	pH	EC umhos/cm	Se µg/L	Cu µg/L	Cr µg/L	Ni µg/L	Pb µg/L	Zn µg/L	Hg µg/L	B µg/L	Cl µg/L	SO4 µg/L	Ca µg/L	Mg µg/L	Na mg/L	K mg/L	CO3 mg/L	Total Alk mg/L	Hard mg/L	TDS mg/L
40 Victoria Island West SJC705	21-Jan-86	55	7.4	1200	<1	0.3	12	2	1	6	<5	6	<0.5	0.50	300	210	0	120	120	64			
	30-Jul-86	1015	74	430	<5	0.3	1	4	<5	7	<0.5	0.17	0.24	44	62	60	40			72			
	10-Sep-86	1420	69	920	0.3	1.4	5	3	1	4	0.56	0.56	0.22	0.24	170	60	61	61			64		
	19-Mar-87	1130	55	956	1.4	461	1.1	0.2	0.1	0.1	0.22	0.40	0.40	0.40	80	70					64		
	8-May-87	1505	74	620	0.4																68		
41 Byron Tract North SJC704	23-Jul-87	75	7.4	1200	0.6	540	0.3	<5	2	1	4	<5	6	<0.5	0.52	72	56				110		
	30-Jul-86	1050	58	6.0	633	1.3																	
	19-Mar-87	1215	76	8.8	763	0.7																	
	8-May-87	1535	76	1300	0.4																		
	23-Jul-87	77	1200	0.6																			
42 Orwood Tract CCC702	2-Sep-87	73	7.4	1100	<1	500	0.4	<5	2	1	4	<5	8	<0.5	0.40	160	240			8	140	148	
	21-Jan-86	64	7.4	1100	<1	500	0.4	<5	6	4	10	<5	20	<0.5	0.28	53	56						
	30-Jul-86	1125	73	500	0.3	500	0.3	<5	6	4	10	<5	20	<0.5	0.28	63	71						
	10-Sep-86	1505	72	1200	0.6																		
	19-Mar-87	1245	60	1245	0.6																		
	8-May-87	1600	76	8.2	563	1.0																	
	23-Jul-87	73	820	0.6																			
	23-Sep-87	71	900	0.7																			
43 Palm Tract CCC703	21-Jan-86	55	7.0	1400	<1	540	0.4	<5	3	1	10	<5	9	<0.5	0.70	150	390			8	130	138	
	30-Jul-86	1155	76	500	0.4	590	0.3	<5	3	<1	7	<5	6	<0.5	0.34	54	120						
	10-Sep-86	1525	74	1080	0.5																		
	19-Mar-87	1315	63	1245	0.6																		
	8-May-87	1620	81	8.0	784	0.8																	
	23-Jul-87	84	780	0.4																			
	23-Sep-87	75	950	0.7																			
44 Upper Jones Tract Northwest SJC701	21-Jan-86	53	7.6	920	<1	500	0.2	7	1	1	4	<5	5	2.6	0.30	180	150			0	92	92	
	30-Jul-86	0835	70	490	0.1	590	0.1	<5	1	<1	<5	<5	2	<0.5	0.21	69	57						
	10-Sep-86	1300	68	1020	0.6																		
	19-Mar-87	1355	58	1020	0.6																		
	8-May-87	1345	73	7.4	712	1.2																	
	23-Jul-87	70	680	0.7																			
	23-Sep-87	68	950	0.4																			
45 Lower Jones Tract Southwest SJC702	21-Jan-86	54	6.7	780	<1	500	0.4	6	2	1	4	<5	5	<0.5	0.30	120	150			0	60	60	
	30-Jul-86	0850	70	470	0.4	510	0.4	<5	7	3	21	<5	13	<0.5	0.22	60	60						
	10-Sep-86	1310	67	815	0.3	815	0.3	0.2	2	<1	3	<5	4	<0.5	0.37	75	88						
	19-Mar-87	1405	57	673	1.4																		
	8-May-87	1350	73	7.0	520	0.7																	
	23-Jul-87	68	520	0.7																			
	23-Sep-87	68	700	0.5																			
46 Bacon Island West SJC703	21-Jan-86	54	7.0	710	<1	500	0.1	<5	2	1	5	<5	5	<0.5	0.20	85	160			0	72	72	
	30-Jul-86	0910	70	270	0.1	590	0.3	<5	2	<1	3	<5	4	<0.5	0.18	28	28						
	10-Sep-86	1330	69	548	0.2	548	0.2	0.2	2	<1	21	<5	4	<0.5	0.16	61	61						
	19-Mar-87	1430	59	495	1.0																		
	8-May-87	1420	71	6.9	540	0.3																	
	23-Jul-87	72	450	0.5																			
	23-Sep-87	65	450	0.5																			

APPENDIX B

Appendix B. Department of Water Resources Delta Agricultural Drainage Investigation Water Quality Data for Selected Sites, August 1987.

Site Name	Time	Date	Temp °C	pH	EC umhos/cm	Se ug/L	B	Cl	SO4	NO3	Ca	Mg mg/L	Na mg/L	K mg/L	Total Alkalinity	Hard	TDS	Dissolved Oxygen
1 Empire Tract PP	745	7-Aug-87	21.3	6.8	732	0.7	0.4	115	51	54	2.5	123	247	487	2.4			
3 Bouldin Island PP-1	1140	6-Aug-87	23.6	7.5	262	0.4	0.1	28	15	21	1.5	65	81	167	7.2			
4 Bouldin Island PP-2	1220	6-Aug-87	25.5	7.2	182	0.7	0.1	8	2.6	12	1.3	58	59	118	7.1			
5 Egbert PP-1	1005	13-Aug-87	19.3	8.5	305	0.7	0.2	12	32	20	17	19	0.5	104	120	205	6.5	
7 Kings Island PP-1	615	7-Aug-87	19.8	7.4	555	0.3	0.2	37	38	4.3	50	24	39	203	224	360	3.2	
8 Kings Island PP-2	720	7-Aug-87	20.4	7.1	503	0.3	0.2	33	8	14	45	16	38	4.7	194	178	332	2.1
9 Kings Island PP-3	700	7-Aug-87	20.1	7.4	945	1.3	0.2	151	52	18	73	38	62	2.8	194	339	564	3.1
10 McCormick Williams PP-1	1210	7-Aug-87	22	7.4	186	0.4	<0.1	7	13	8.8	13	8	11	1.5	64	66	116	6.5
11 McCormick Williams PP-2	1245	7-Aug-87	25.3	7.4	173	2.3	<0.1	7	8	4.3	12	8	11	1.7	74	63	109	7.1
12 Mossdale PP-1	920	14-Aug-87	18.9	8.2	842	1.0	0.3	132	95	4.9	41	19	96	6.8	110	180	506	2.9
13 Mossdale PP-2	905	14-Aug-87	20	8.3	690	0.4	0.3	93	80	3.7	40	17	72	3.0	112	170	424	3.6
14 Mossdale PP-3	845	14-Aug-87	16.5	8.4	980	0.9	0.5	148	121	4.7	57	28	113	4.5	142	257	616	3.5
15 Mossdale PP-4	810	14-Aug-87	17.8	8.6	1970	0.3	0.5	289	183	3.5	89	59	274	3.7	454	465	1220	4.3
16 Mossdale PP-5	720	14-Aug-87	17.9	8.5	922	1.4	0.4	134	110	6.1	48	23	115	4.8	145	215	554	3.4
17 Mossdale PP-6	1045	5-Aug-87	23.5	7.0	969	2.3	0.6	130	146	13	58	27	106	10	132	256	605	1.0
18 Mossdale PP-8	1005	5-Aug-87	24.6	7.7	886	2.5	0.6	124	116	9.3	48	25	102	4.8	134	223	533	6.1
19 Mossdale PP-9	950	5-Aug-87	22.1	7.6	917	1.3	0.6	125	108	1.2	53	27	104	7.0	168	243	561	7.1
20 Mossdale PP-10	1005	14-Aug-87	18.3	8.5	1370	0.7	0.4	134	167	21	61	40	196	3.0	360	317	853	2.0
22 Moss Tract PP-2	1105	14-Aug-87	22.6	8.3	838	0.7	0.4	134	93	5.6	36	20	104	4.8	112	172	506	6.2
23 Moss Tract PP-3	1045	14-Aug-87	22.8	8.3	601	0.5	0.2	82	63	6.4	30	16	66	5.4	96	141	366	7.0
24 Netherlands Tract PP-1	730	13-Aug-87	17.6	8.4	289	0.4	0.2	15	19	3.4	15	17	22	0.7	104	108	173	8.1
25 Netherlands Tract PP-2	700	13-Aug-87	18.6	8.2	243	0.7	0.1	9	14	3.9	16	13	15	0.7	92	94	160	5.0
26 Pescadero Tract PP-1	730	5-Aug-87	22.2	7.4	1480	2.3	0.9	243	187	8.1	85	46	159	5.5	181	401	920	3.1
27 Pescadero Tract PP-2	800	5-Aug-87	22.4	7.4	1750	1.8	1.0	291	226	8.6	97	54	196	6.7	207	464	1070	5.4
28 Pescadero Tract PP-3	830	5-Aug-87	22.2	7.5	1770	2.0	0.9	300	221	14	103	57	183	5.1	190	492	1140	5.9
29 Pierson Dist PP-1	730	6-Aug-87	22.5	7.5	248	0.6	0.1	15	11	0.3	17	11	17	1.6	98	88	154	5.8
30 Prospect Island PP-1	845	13-Aug-87	19.4	8.1	200	0.3	0.1	7	15	2.6	14	11	12	1.2	74	80	128	4.8
32 Rindge Tract PP-1	830	7-Aug-87	20.4	6.7	611	0.3	0.4	79	89	4.8	31	15	60	2.1	58	139	369	3.9
33 Rindge Tract PP-2	910	7-Aug-87	22.2	6.6	363	0.8	0.2	43	42	1.5	24	12	31	1.4	71	110	250	3.3
34 Rio Blanco PP-1	1015	7-Aug-87	21.1	7.8	1290	0.2	0.1	181	55	9.3	62	52	138	2.0	320	369	789	8.6
35 Rio Blanco PP-2	955	7-Aug-87	21.2	7.5	450	0.7	0.1	38	26	5.7	33	16	38	4.1	148	149	248	4.1
36 Shima Tract PP	1105	7-Aug-87	21.8	7.4	631	0.3	0.1	55	34	5.3	59	23	47	1.6	221	242	319	4.4
37 Terminous Island PP-1	1315	6-Aug-87	24.7	7.3	472	0.4	0.1	59	26	6.4	33	20	33	1.6	116	165	288	6.1
38 Terminous Island PP-2	1330	6-Aug-87	23.6	7.4	587	0.4	0.1	99	21	4.4	35	23	46	2.0	115	182	357	6.5
42 Upper Jones Tract PP-2	850	12-Aug-87	20.4	7.0	505	0.5	0.2	80	23	8.0	26	19	44	4.0	94	143	327	3.0
43 Brannan-Andrus PP-2	1105	6-Aug-87	22.1	7.2	294	0.4	0.1	36	18	1.4	15	10	29	2.2	71	79	177	5.5
44 Brannan-Andrus PP-2	945	6-Aug-87	22.6	7.4	671	0.5	0.2	102	46	0.3	38	31	50	3.2	141	223	404	7.2
45 Brannan-Andrus PP-3	1015	6-Aug-87	22	7.4	328	<0.2	0.1	37	18	2.8	16	12	32	1.8	85	90	193	6.3
46 Brannan-Andrus PP-4	1045	6-Aug-87	22.4	7.5	268	0.5	0.1	12	16	9.6	24	10	2.5	92	101	180	9.2	
49 Mossdale PP-11	945	14-Aug-87	18.2	8.4	382	0.6	0.3	22	37	15	20	20	31	2.5	115	132	251	7.3
52 Upper Egbert Tract PP-1	1040	13-Aug-87	18.6	8.4	375	0.6	0.3	20	34	4.6	22	22	28	1.4	125	146	230	7.0
53 Upper Egbert Tract PP-2	1110	13-Aug-87	18.3	8.3	538	1.0	0.3	60	44	3.1	27	29	49	6.4	156	187	337	6.6
54 Upper Egbert Tract PP-3	1130	13-Aug-87	20	8.3														

